INSTRUCTIONS

FOR

THE MANAGEMENT OF

THE

Blow-pipe & Chemical Tests:

WITH

AN APPENDIX

FROM

BERZELIUS.

Price. 1s.

Chemical Tests.

INSTRUCTIONS

FOR

THE USE

OF

THE BLOW-PIPE,

AND

Chemical Tests,

WITH

Additions and Observations derived from the Recent Publication

OF

PROFESSOR BERZELIUS,

BY

J. MAWE.

FOURTH EDITION.

LONDON:

PRINTED FOR AND SOLD BY THE AUTHOR,
149, STRAND;

AND BY LONGMAN, HURST, REES, ORME, BROWN, AND GREEN, PATERNOSTER-ROW.

1825.

LIST

Of useful Articles composing

THE CHEMICAL APPARATUS.

BLOW-PIPE, with extra mouth-piece and nozel.

Glass Blow-pipe.

Steel Mortar, for reducing fragments to powder.

Electrometer and Magnetic Needle.

Platina Spoon and Forceps.

Spirit Lamp, for effecting solution by heat, without discoloring the glass vessels.

Magnet.

Magnifying Glass.

Knife, with File, Forceps, and Magnet.

Brass Forceps.

Brass Frame, for holding evaporating glasses.

Tubes, Watch Glasses, Wax Candle, Charcoal.

TESTS.

In Bottles with ground stoppers.

Nitrate of Silver	Tincture of Galls
Carbonate of Ammonia	Carbonate of Soda
Oxalic Acid	Nitrate of Barytes
Super Acetate of Lead	Prussiate of Potash

ACIDS.

In Bottles, with ground stoppers and caps, to prevent the fumes escaping.

Nitric Acid, engraved *N.*

Muriatic Acid, engraved *M.*

Sulphuric Acid, engraved *S.*

FLUXES.

Glass Borax	Cream of Tartar.

METALLIC RODS.

Copper	Zinc
Iron	Tin

IN order to facilitate the acquiring a knowledge of Mineralogy, Collections of the Metals, Earths, and Rocks, are formed in Mahogany Cabinets, at the following Prices:—

100 Small Specimens of Metals, Earths, and Rocks	£ 2	2	0
100 Ditto, with Blow-pipe, Magnet, Forceps, Tubes, Fluxes, &c.	2	12	6
200 Ditto, ditto, with Mawe's New Descriptive Catalogue of Minerals.	4	4	0
190 Ditto, ditto, larger, with ditto.	5	5	0
222 Ditto.	10	10	0

Collections containing a greater variety of substances at Twenty Guineas, and upwards.

Fragments for Experiments, at One Shilling per Packet.

ON THE

MANAGEMENT

OF

THE BLOW-PIPE.

THE Blow-pipe is a most valuable little instrument to the Mineralogist, as its effects are striking, rapid, well characterized, and pass immediately under the eye of the operator.—Some difficulty generally attends the first attempts to use it, but with a little perseverance the habit will soon be acquired; perhaps no caution can be more essential than that of *not working too hard*, as the most efficacious flame is produced by a regular, moderate stream of air, while the act of blowing with more force

only has the effect of fatiguing the muscles of the cheeks, oppressing the chest, and at the same time renders the flame unsteady.

First, let the student accustom himself to breathe freely through the nostrils, with the mouth closed; when this can be done without inconvenience, let him fill his mouth with air, so as to inflate the cheeks moderately, and continue to breathe without letting the air in the mouth escape; a few trials will accomplish this. The Blow-pipe may then be introduced between the lips, and while the breathing is carried on by the medium of the nose, the cheeks will expel a stream of air through the Blow-pipe; and by replenishing the mouth at each expiration, and merely discharging the *surplus* air through the nostrils, a facility will be acquired of keeping up a constant stream of air without fatigue.

THE best flame for the purpose of this instrument is that of a thick wax candle, (such as are made for the lamps of carriages); the wick being snuffed of such a length as to occasion a strong combustion, it should be deflected a little to one side, and the current of air directed along its surface towards the point; a well defined cone will be produced, consisting of an external yellow, and an internal blue flame. At the point of the former, calcination, the oxidation of metals, roasting of ores to expel the sulphur and other volatile ingredients, may be accomplished; and by the extreme point of the latter (which affords the most intense heat) fusion, the de-oxidation of metals, and all those operations which require the highest temperature, will be effected. The piece of mineral to be examined must necessarily be supported on some substance; and, for the earths, or any subject not being metallic, or requiring the ope-

ration of a flux, a spoon or pair of forceps made of Platina will be found useful; but as the metals and most of the fluxes act upon Platina, the most serviceable support, for general purposes, will be a piece of sound well burnt charcoal, with the bark scraped off, as free as possible from knots or cracks; the piece of mineral to be examined should not in general be larger than a pepper-corn, which should be placed in a hollow made in the charcoal; and the first impression of the heat should be very gentle, as the sudden application of a high temperature is extremely liable to destroy those effects which it is most material to observe.—Many substances decrepitate immediately they become hot, and when that is found to be the case, they should be heated red, under circumstances which will prevent their escape; this may be effected with the earthy minerals, by wrapping them in a piece of platina foil, and

with the metallic ores, by confining them between two pieces of charcoal, driving the point of the flame through a small groove towards the place where the mineral is fixed; by which means a sort of reverberating furnace may be formed. The principal phenomena to be noticed are phosphorescence, ebullition, intumescence, the exhalation of vapors having the odor either of sulphur or garlic, (the latter arising from the presence of arsenic), decrepitation, fusibility, and among the fusible minerals, whether the produce is a transparent glass, an opaque enamel, or a bead of metal.

HAVING first made some observations on a particle of the mineral alone, either the residue or a fresh piece should be examined with the addition of a flux, more particularly in the case of the ores, as the nature of the metal may be generally decided by the color with which it

tinges the substance used. The most eligible flux is glass of borax; a piece, about half the size of a pea, being placed on the charcoal, is to be heated till it melts, the particle of ore being then taken in a pair of forceps, is to be pressed down in it, and the heat applied; or should the mineral not be inclined to decrepitate, it may be laid on the charcoal, and two or three pieces of glass of borax, about the size of a pin's head, placed over it; and on using the blow-pipe the whole will form itself into a globular bead.

I WOULD advise the learner to commence with a piece of common *Lead Ore*, which should be placed in the hollow of the charcoal, *(See Frontispiece)*, and after having first submitted it to the yellow flame, in order to drive off the sulphur, it may be brought within the action of the blue flame, when it will instantly melt into

a bead of lead, the charcoal at the same time being colored yellow. He may then proceed with the following metals*.

White Lead Ore—Apply the flame gently, as before, and the mineral will exhibit an orange or red color, and afterwards melt into small globules.

Silver—A particle melts into a brilliant ball, which on cooling becomes dead white. Silver Ores, if not very poor, will discover a bead of Silver by repeated melting *with* or *without* borax.

Copper Ores—except they are very poor,

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* Small Boxes containing 100 fragments of various Minerals, selected for Experiments, may be had at one or two Shillings each box.

may be easily melted into a bead of Copper, or detected by Nitric Acid.

Pyrites—is subject to decrepitate, therefore requires the heat to be very delicately applied. The sulphur will then evaporate, and leave a scoria of iron which is attracted by the magnet.

For general observations and a detailed account, refer to Familiar Lessons on Mineralogy, where the subjects under each head are fully explained.

It would far exceed the limits necessarily assigned to this slight sketch, to point out the various effects produced by the several metallic and earthy minerals when acted upon by the blow-pipe. Having put the student into the way of using it, we may hope, with some confi-

dence, that the examination of a few specimens, by means of the tests and blow-pipe, will excite a degree of interest which will lead to the further pursuit of studies, in which he must avail himself of the assistance to be derived from experience and more extensive works.

DESCRIPTION AND USE

OF

THE ACIDS, CHEMICAL TESTS,

&c. &c. &c

ADAPTED TO ASSIST THE LEARNER.

SULPHURIC ACID.

DISCOVERS the presence of many other acids: it detects the *Carbonic* by causing a brisk inodorous effervescence; the *Nitric* by disengaging fumes, which become orange by contact with atmospheric air; the *Muriatic* by white fumes, which become beautifully distinct by holding near to them a stopper or feather moistened with ammonia; the *Acetic* by the escape of pungent vapors, having the well-known odor of aromatic vinegar; and the *Flu-*

oric by the moderate effervescence, arising from suffocating fumes, which rapidly corrode glass exposed to their action.

FROM *Metallic Solutions*, it precipitates *Lead* and *Mercury* in heavy white clouds; they may be distinguished by the *latter* acquiring a yellow tinge when covered with boiling water.

THE earths thrown down by this acid, are Barytes, Strontian, and Lime; the two first are totally insoluble, but the last is soluble in about 500 parts of water, and even less, if an excess of acid should be present.

NITRIC ACID

Is extremely useful in the examination of minerals, from its powerful action on most of the

metals and earths. To use it, place a small portion of the mineral finely powdered in a watch glass, or small glass tube, and pouring over it a little of the acid, expose the mixture to the heat of a spirit lamp or common candle; the solution is then ready for examination, by exposing small quantities of it separately to the action of the various tests; which is best done in narrow glass tubes, into which about an equal quantity of water may be previously poured.

As a *test*, this acid is of no use, except occasionally to an experienced person. Care should be taken to prevent its touching the fingers, as it stains the skin a deep and permanent yellow.

MURIATIC ACID

Is useful as a solvent, in the same manner as the Nitric Acid, though some metals, as Lead and Silver, are not dissolved in it. Tin, on the contrary, is readily soluble in Muriatic Acid; the action of Nitric Acid on that metal is very violent, converting it into an insoluble white oxide.

As a test, it discovers Silver and Lead, with which it forms a white precipitate; the former becomes black by exposure to light, is insoluble in water, and soluble in liquid Ammonia; the latter is not affected by light, and is soluble in Nitric Acid, or in about 25 parts of boiling water: it also detects Manganese by the disengagement of Chlorine, when exposed to heat with the powder of any mineral containing a considerable proportion of that metal.

OXALIC ACID

Is used to separate the oxides of Titanium or Cerium from that of Iron, the two former being precipitated, while the iron remains in solution; but the chief application of this acid is for the detection of Lime. Oxalate of Ammonia being, however, far preferable for this purpose, it may be formed at the moment required, by mixing a little of the acid in a tube with Ammonia; on adding it to a solution containing Lime, the smallest particle will be discovered; it will shew the presence of Lime in almost any spring water. Magnesia, if in any quantity, will be precipitated, but not until after some hours. Should Barytes or Strontian be present, they must be previously removed by Sulphuric Acid.

NITRATE OF SILVER

Is a most delicate test for Muriatic Acid, with which it forms a white curdy precipitate, which speedily blackens by exposure to light. With Sulphuretted Hydrogen, or any Sulphurets, it forms a black cloud, and with Chromic Acid a carmine red precipitate.

AMMONIA

Is chiefly useful for the detection of Copper and Nickel; when added in excess to any solution containing those metals, they will be redissolved of a beautiful bright blue: to distinguish the Copper from the Nickel, add Sulphuric or Nitric Acid till the color has disappeared, and on immersing a bar of Zinc, the Copper will be

precipitated, but not the Nickel. Many other metals are thrown down by this test: as Mercury, of a white color, which turns brown; Silver, grey; Iron, brown; Platina, buff; Zinc, white, which redissolves in excess of Ammonia.

ACETATE OF LEAD

Discovers Carbonic, Muriatic, or Sulphuric Acid, by a white precipitate: the Carbonic is known by the precipitate effervescing with Nitric Acid; the Muriatic by its being soluble in Acetic or dilute Nitric Acid, which that produced by the Sulphuric Acid is not. Should a mineral contain *Phosphoric* Acid, a white precipitate will be formed, which may be known by the following characters: heated by the blow-pipe on charcoal, it forms a pearly globule, which assumes a polyhedral form imme-

diately the heat is discontinued; on again applying the blow-pipe, the Phosphoric acid is decomposed, burning away with the smell of phosphorus, and a globule of pure Lead is left. This is a very delicate test for Sulphuretted Hydrogen, or Sulphurets in general, forming with them a black cloud.

TINCTURE OF GALLS

Is a valuable test, from its extensive application to metallic solutions; but, as it is influenced by the presence of other bodies, it will be well to neutralize very carefully any excess of acid, (with the carbonate of soda), previously to using the test*. The metallic precipi-

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* This habit of being affected by foreign substances may also occasion some variation in the tinge of the precipitate.

tates are: Lead, white; Cobalt, yellowish white; Nickel, greyish white; Bismuth and Mercury, orange; Silver, yellowish brown; Chrome, brown; Copper, brownish; Molybdena, deep brown; Titanium, reddish brown; Uranium, chocolate; Platina, dark green; Iron, black—for the latter it is a very delicate test.

PRUSSIATE OF POTASH

Is, on the whole, the most valuable test possessed by the mineralogist, from the immediate and characteristic effect produced on nearly all the metallic solutions, without the disadvantage of having its effect much impeded by foreign bodies, as is the case with Tincture of Galls.

With Iron, it forms at once the vivid tint of

Prussian blue; with Antimony, Arsenic, Lead, Silver, Tin, and Zinc, its precipitates are white; (if these metals be impure, the precipitates are more or less colored); Bismuth and Manganese, yellowish white; Cobalt, brownish yellow; Mercury, white, which turns yellow; Chrome, green; Nickel, sea-green; Titanium, grass-green; Copper and Molybdena, brown; Uranium, reddish brown*.

NITRATE OF BARYTES

Is a useful test for the discovery of Sulphuric Acid, with which it forms a heavy white pre-

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* Mr. Brandenburg recommends the triple Prussiate of Ammonia as preferable for the detection of Iron, which it precipitates blue; and as being also a most delicate test for Copper, if present, with which it forms a precipitate of a very fine red.

cipitate, insoluble in water or acids, but melting before the blow-pipe into an opaque milky globule; the carbonates also throw down a heavy white powder, but it is immediately known by its being re-dissolved with effervescence in Nitric or Muriatic Acid.

This test is frequently serviceable for freeing nitric solutions from the admixture of Sulphuric Acid, which arises from the oxygenation of the sulphur, when the metallic sulphurets are exposed to the action of that acid.

CARBONATE OF SODA

Throws down a white precipitate with Lead, Titanium, and Uranium; a peach or lilac one with Cobalt, and a blue one with copper; it should also be kept for the purpose of neutra-

lizing occasionally the excess of acid in metallic solutions, which, if considerable, always more or less affects the action of other tests.

It is sometimes useful as a flux for the blow-pipe, particularly in the examination of the ores of Tin.

The following HINTS *are recommended to the Attention of the Learner.*

PREVIOUSLY to exposing any mineral to the action of an acid, let it be reduced to a tolerably fine powder, which will speedily be effected by the steel mortar.

HAVE at hand a basin and some water in a pitcher, *with a spout*, from which you may pour the water into the tubes, &c. without danger of contaminating that which remains in the pitcher. Let every tube of glass be thoroughly washed from its old contents before any thing new is put into it, to prevent any adhering remains of the last experiment occasioning a doubtful result. Do not engage in the examination of too many substances at one

time; and it will be of very great advantage to keep a small book, in which to note down, at the moment of examination, every appearance from the action both of the solvent and the various tests, placing a number as well on the specimen as in the book, to facilitate future reference. Never apply two different tests to the *same portion* of a solution. Do not rest satisfied with the examination of any solution by a single test, but avail yourself of the opportunity of confirming your results by as many means as may be at hand. *Practise as much as possible comparative experiments on substances, the nature of which you are certain of.*

ARTICLES OF APPARATUS.

IN addition to the tests already treated of, the following small articles of Apparatus will be highly useful for the purpose of examining some of the most striking physical characters of minerals.

A MAGNET—to ascertain the presence of iron, which is immediately detected by it in some ores of that metal, as well as in those of titanium, more particularly if they be reduced to powder, and exposed to a red heat for a few seconds. It is also of much service in examining the result of an experiment with the blow-pipe, as numerous ores on which the

magnet had originally no action, become highly affected by it after being exposed to heat.

A Magnetic Needle—for similar purposes, and also to detect those minerals which naturally possess magnetic polarity. For the latter purpose the needle should be but slightly magnetized.

An Electrometer—to discover whether minerals are susceptible of electricity by friction or heat: it is a brass wire, terminated by two balls, and is supported from its centre on a fine metallic point, (which serves also for the magnetic needle). The wire being placed on the point, heat a tourmaline or topaz, and on presenting it to the Electrometer, the ball nearest to it will be attracted, shewing that the mineral has become electric; to determine whether the electricity be positive or negative,

the experiment must be conducted as follows: Insulate the Electrometer by placing it on a reversed tumbler or wine glass; then take one of the small glass tubes, and rub it briskly upon a woollen cloth, by which it becomes positively electrified; now, placing a finger on the stand of the Electrometer, bring the tube within a short distance of one of the balls; after a few seconds withdraw the finger, and then the tube. The Electrometer is now electrified negatively, and on presenting the mineral, the ball will either approach or recede, according to the kind of electricity which the specimen possesses.

THE STEEL MORTAR—is so constructed as to reduce minerals to powder without a particle escaping. It is of great use in breaking the globules melted by the blow-pipe, the particles of which it is often necessary to examine with a magnifying glass.

The Knife—is indispensable; for convenience it may contain a file, forceps, and bar magnet. It is recommended to learners to try every specimen with the point, in order to obtain a knowledge of comparative hardness, color of streak, texture, and sectility.

Platina Forceps—should be used to hold the watch glass over the flame of the lamp when the acids are employed in it.

Glass Tubes—are extremely necessary to hold solutions, and may be used as follows:—Suppose a particle of Copper ore has been submitted for a minute or two to a few drops of nitric acid in a watch glass, with or without being heated, pour the contents into a tube previously containing a little water, into which plunge a rod of iron, and it will become covered with a film of copper. Effervescence is produced and exhibited to great advantage,

by dropping a little marble or calcareous spar reduced to powder into a tube containing a few drops of weak or diluted acid. The acids may be taken out of the bottles by the smaller tubes, open at each end, in an elegant manner, without the possibility of their coming in contact with the skin, by dipping the tube into the acid as deep as necessary; then stop the outer end with the finger, and withdraw the tube, which will bring out acid according to the depth it was immerged; and on taking the finger away, it will run out.

The Watch Glasses—are intended to contain the mineral and acid in experiments on a small scale.

Spirit Lamp—to be used with alcohol; as it does not emit smoke, the experiments are conducted much more agreeably. It may be

also used with the blow-pipe, particularly where smoke would injure the effect.

THE WAX CANDLE—need only have a wick double the ordinary size.

RODS OR CYLINDERS—of Zinc, Iron, Copper, and Tin, to produce metallic precipitates from solutions of the ores, and which will be found very satisfactory in certain cases.

Zinc—precipitates lead, copper, tin, silver, and tellurium.

Iron—will shew the presence of copper, antimony, or tellurium.

Copper—in a solution containing silver, becomes coated with that metal, of a dark muddy brown color.

Tin—is chiefly used to detect the presence of gold; if immerged in a solution containing that metal, the Tin will become coated with a

purple powder, and the fluid will gradually assume a purple tinge.

When the metallic cylinders are used, the solution should always contain a slight excess of acid.

Platina Foil—for enveloping any of the earthy minerals, to prevent the escape of such as are likely to decrepitate when exposed to a strong heat.

FLUXES FOR THE BLOW-PIPE.

Glass of Borax—for general purposes, answers sufficiently well; but the learner may provide himself with other substances, which may be found serviceable on particular occasions. Where a strong reducing flux is required, a few grains of

CREAM OF TARTAR—may be added to the borax. When it is desirable to keep some of the metals in a high state of oxidation,

NITROUS BORAX is the best flux, which may be had ready prepared.

CHARCOAL—is to be used as before mentioned, page 4.

OBSERVATIONS

ON

THE METALS AND EARTHS SUBJECTED TO THE HUMID PROCESS.

IT may be of some advantage to point out to the learner the most distinguishing properties by which the various metals may be detected, with a view of facilitating the examination of such minerals as may present themselves to his notice; but at the same time it may be necessary to observe, that, on exposing a portion of ore to the action of an acid, the solvent may become charged with various proportions of three or four different metals, and perhaps also of one or two earths: this complication will of course prevent the result being so striking as

would be the case if the solution were of a more simple nature: this circumstance is mentioned, to caution the young student against being deterred by an unexpected difficulty at the outset.

SHOULD he have reason, however, to suppose that he has commenced with an investigation beyond his power, let him set the specimen aside, and by operating upon others of less complicated natures, he will gradually extend his sphere of observation, and after a short time have the satisfaction of resuming the examination of the subject, which at first baffled his attempts.

GOLD.—Muriate of tin * throws down a

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* Prepared by dissolving a few grains of pure tin in muriatic acid; this test must be used *fresh prepared*.

purple precipitate, and green sulphate of iron* a brown one, which is metallic gold.

SILVER.—By the solution of a few grains of common salt, or any other substance containing muriatic acid†. On immersing a piece of copper wire, it will become coated with a film of metallic silver of a dark sooty appearance.

COPPER—affords a beautiful blue by the addition of ammonia‡, and coats the surface

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* Prepared by diluting a few drops of sulphuric acid with an equal quantity of water, and throwing into it a small nail, or any other piece of iron.

† See muriatic acid, in the description of the various tests contained in the box.

‡ See ammonia in the description of the various tests contained in the box.

of a piece of polished iron with a film of copper *.

IRON—by the vivid Prussian blue which is immediately formed on the addition of one or two drops of Prussiate of potash.

LEAD—by being precipitated upon zinc, or by common salt, or any of the muriates. To distinguish it from silver, see the article muriatic acid, in the list of tests.

MERCURY—by an orange precipitate,

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* For copper, in the state of *oxide*, the most delicate test is, perhaps, the flame of a candle: a few particles of powder containing oxide of copper, being applied on a platina point to the blue part of the base of the flame, will communicate a green tinge: and this has been found to succeed when the other most sensible tests have failed.

which it affords with the pure alkalies, or by exposing the mineral suspected to contain it to the action of the blow-pipe, when the fumes will coat the surface of a piece of copper (a bright halfpenny, for instance,) held over the charcoal, with a thin silver-like crust of mercury.

TIN—by the purple precipitate afforded by muriate of gold *.

COBALT—by the bright blue bead afforded by exposing a *very small* particle† of it to the blow-pipe with the glass of borax.

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* Formed by putting a little gold leaf into a tube or watch glass, with a small quantity of muriatic acid, and adding a few drops of nitric acid, assisting the solution with the heat of a lamp or candle.

† Cobalt and manganese afford so intense a color, that (unless the particle of ore be very small) it might be taken for black.

MANGANESE—by the amethystine tinge which the bead of borax assumes under the same circumstances, and by its yielding the suffocating fumes of chlorine, when heated with muriatic acid.

ANTIMONY and BISMUTH—both yield a white precipitate, when the acid containing them in solution is poured into water*; but they may be distinguished by the blow-pipe, before which the antimony flies away in white fumes, which coat the charcoal to some distance.

ARSENIC—by the unpleasant garlic-like odor which it yields before the blow-pipe, at the same time affording white fumes.

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* It is essential that the solution be poured into the water, and not the water into the solution.

ZINC—by the white precipitate it affords with ammonia, in an excess of which it re-dissolves; also by forming *brass*, when carefully fused with a few grains of copper filings before the blow-pipe.

THE striking characteristics of the several metals, arising from their odor when exposed to heat, or the color of their precipitates when acted on by tests, afford a much greater facility in their detection than exists with the earths. The latter, with the exception of the peculiar earthy smell arising usually from the presence of clay, (but existing also in some minerals containing but little alumine), yield scarcely any odor. The colors they exhibit are always owing to metallic oxides, and their precipitates are invariably white: it according-

ly requires a nicer discrimination to satisfy the mind with respect to them; but a habit of observation will gradually render their principal features familiar. The following hints may perhaps be serviceable: it is admitted that some of them are not confined to the particular substance referred to, but the exceptions relate to objects much less likely to be submitted to examination. Thus, the hardness and insolubility of Silex apply equally to the purer forms of Alumine, as existing in Sapphire and some other gems, which are not likely to become the subjects of a young mineralogist's experiments.

SILEX—usually imparts a considerable degree of hardness and insolubility. Minerals which chiefly consist of it are, for the most part, transparent; and although many may appear by the knife to be soft, it will be found

to arise from the presence of other earths in a state of mechanical combination; the particles of Silex still retaining their hardness, as will be proved by rubbing some of the powdered mineral over the moistened surface of a piece of glass, which will speedily lose its polish.

LIME—is immediately precipitated by oxalate of ammonia, but which also throws down barytes and strontian. These three earths are precipitated by the alkaline sulphates; and the sulphate of lime may be separated by the affusion of a large quantity of water slightly mixed with sulphuric acid, the sulphates of barytes and strontian being totally insoluble.

ALUMINE—in a state of great purity, affords gems possessing a high degree of hardness and brilliancy; while its combinations are most frequently soft, and of a dull earthy ap-

pearance, yielding the peculiar smell of clay when breathed upon, and adhering to the tongue or moistened lip. Should the specimen not contain any large portion of metal, the presence of Alumine may be ascertained by dropping a very small quantity of strong nitrate of cobalt on a particle of it: on applying the blow-pipe heat a blue color will appear, the vividness of which will be in proportion to the purity of the Alumine. This will not be the case with any of the other earths except zircon, an ingredient of very rare occurrence.

MAGNESIA—may be detected by pouring into the solution a few drops of concentrated *neutral* carbonate of ammonia, and then adding a little phosphate of soda, when a precipitate will be obtained, consisting of phosphoric acid combined with soda and Magnesia;

or, after precipitating all the earths by any carbonated alkali, wash the precipitate and pour over it moderately diluted sulphuric acid: silex, lime, barytes, or strontian, will remain undissolved; Magnesia or alumine will form a soluble combination; and to distinguish them add a particle or two of potash, and after moderately evaporating the mixture in a watch glass, set it by to crystallize. Should the earth in combination be Magnesia, the result will be the well known Epsom salts, but if alumine, the produce will be alum.

BARYTES or STRONTIAN—are almost immediately known by the superior weight of their combinations. They are found united to the sulphuric and carbonic acids only: with the former, they are insoluble either in water or any of the acids; with the latter, they dissolve in diluted nitric or muriatic acid, and may be

discriminated by the following experiments:— evaporate the mixture to dryness, and expose a small quantity of the residue to the blow-pipe, Strontian will impart a crimson color to the flame, a property not possessed by barytes*.

THE remaining metals and earths, being of comparatively rare occurrence, do not call for particular notice in a short sketch of this description.

THE learner possessing a mineral, with the nature of which he is unacquainted, may pro-

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* Much useful information upon the Humid Process, will be found in Park's excellent Chemical Catechism, or Brande's Manual of Chemistry.

ceed as follows:—If it be both earthy and metallic, he should separate one from the other, and reduce a few grains to powder, which he should place in a watch glass, and add a few drops of nitric acid; if no action be perceived, it may be held over the flame of the lamp, until ebullition takes place*, when the substance will be more or less dissolved; then pour the liquid into a glass tube, previously containing a little water, and proceed by applying the tests or metallic rods, before explained.

Or expose the substance to the yellow flame of the blow-pipe, after which pulverize it, and apply the magnet to it, which will frequently

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* This is best done in the fire place, or where the fumes of the acid can escape, or by holding a wet cloth loosely over the acid, upon which the fumes will be condensed.

determine the substance, iron being so generally disseminated: or, place it in the hollow of the charcoal, with an equal quantity of glass borax, and expose it to the blue flame, when it will melt into a bead surrounded by the borax forming scoria. Care must be taken not to apply too much heat, as some of the metals evaporate, or become oxidated.

APPENDIX.

A PERFECT habit of discriminating minerals by means of the blow-pipe, requiring a combination of study and experience, it can no more be expected that an introduction of this nature should make an able operator, than that the most simple elementary grammar should enable its possessor to become master of a foreign language. The object in view is to impart a knowledge of the means to be adopted for accomplishing the *mechanical* process, and thereby to qualify the student to perform the various operations pointed out in more elaborate

works. The following very slight outline of the principal effects of the blow-pipe on different minerals, may be of use to the learner; who, however, should be aware that many circumstances conspire to modify the appearances, it sometimes happening that the same description of mineral, but from different localities, will produce effects varying in many points, owing to the accidental presence of some foreign bodies.

HAVING by means of this little work surmounted the first difficulties, and acquired a general idea of the art, the learner cannot possess a more valuable instructor than the treatise recently published by Professor Berzelius. In the following sketch we have frequently availed ourselves of his observations, and can strongly recommend his book as a masterly production of superior genius. In his hands the

blow-pipe has become a most efficient instrument, and he accordingly speaks of it as one for which "the mineralogist has an absolute "necessity; it is his only resource when he "would ascertain at the moment, whether the "conclusions he may have drawn from the ex-"terior characters, such as color, form, hard-"ness, &c. are correct.

The following minerals will be found incapable of fusion when operated upon without the addition of a flux:—

Spinel.	Automalite.
Topaz.	Ceylanite.
Pycnite.	Sapphire.
Beryl.	Chrysoberyl.
Zircon.	Leucite.

Grenatite.	Pymelite.
Quartz.	Lithomarge.
Hornstone.	Cimolite.
Chalcedony.	Rhombspar.
Hyalite.	Carbonate of Lime.
Opal.	Apatite.
Menilite.	Strontianite.
Andalusite.	Porcelain Earth.
Saussurite.	Tripoli.
Indianite.	Floatstone.
Cyanite.	Chlorite.
Bronzite.	Chiastolite.
Anthophyllite.	Steatite.
Hyperstene.	Serpentine.
Jasper.	Potstone.
Azurite.	Plasma.
Chrysolite.	Chondrodite.
Olivine.	Crichtonite.
Sodalite.	Gehlenite.

Red Siberian Tourmaline.

Hyacinth—loses color but not transparency.

Chrysoprase—loses color and transparency.

Wavellite—but becomes opaque and soft.

Magnesite—but becomes sufficiently hard to scratch glass.

The following melt with more or less difficulty into a bead having the appearance of glass or enamel, or into a hard scoria.

Into a white Glass.

Harmatome.
Common Phosphorite.
Rock Cork.
Emerald (with difficulty).
Porcelain Jasper.
Natrolite.
Adularia.
Tourmaline.
Scapolite.
Sahlite.
Diopside.

Into a white Enamel.

Euclase.	Mica.
Gypsum.	Jade.
Vulpinite.	Pearlstone.
Glauberite	Prehnite.
Witherite	Apophyllite.
Heavy Spar.	Felspar(compact).
Elaolite.	Bergmanite.

Talc (with much difficulty).

Into a white opaque mass.

Tremolite.	Chabasite.

Mostly into a white glass or enamel, but, on the first impression of heat, intumesce very considerably.

Prehnite.	Stilbite.
Zeolite.	Laumonite.

Dipyre. Lepidolite.

Meionite. Botryolite.

Datolite—intumesces very much, then becomes a milk-white mass, and afterwads melts into a bead of a pale rose color.

Vesuvian—into a yellowish, faintly translucent, glass.

Boracite—with ebullition, to a yellowish enamel.

Into a grey Glass.

Glassy Felspar. Clinkstone.

Common ditto. Obsidian (swells much)

Spodumen.

Iolite—with difficulty to a greenish grey enamel.

Dialage—slowly on the edges, to a grey scoria.

Into a greyish-black Glass.

Axinite. Hornblende.

Actynolite.

Into a black Glass.

Basalt. Asbestus.

Magnesian Epidote.

Into a black Enamel.

Garnet (frequently a slag). Yellow Earth.

Cinnamon Stone. Melanite.

Allochroite.

Into a black Scoria.

Green Earth. Epidote.

Schorl. Lievrite.

FLUOR SPAR—decrepitates strongly, loses color and transparency, and finally melts to a greenish-white glass.

SPARRY ANHYDRITE—does not exfoliate and melt, like sparry gypsum, but becomes glazed over with a friable white enamel.

CELESTINE—melts into a friable white enamel, without tinging the flame red; and, after a short exposure, it becomes opaque and somewhat caustic.

CRYOLITE—runs into very liquid fusion, then hardens, and at length appears like a slag.

METALLIC SULPHURETS — usually yield an odor of sulphur when heated on charcoal, or in a glass tube. Should the quantity be too small to be detected by the smell, form a globule of glass, by fusing together silex and soda; and on heating it with a small particle

of the mineral containing sulphur, the bead on cooling will become red or yellow, according to the quantity of sulphur in the ore. After roasting gently a particle of ore, should the metal not have been fused so as to become manifest, it may be treated with a flux.

The following are the appearances which will usually be noticed with glass of borax:—

Tantalium—a colorless glass.

Titanium—hyacinth red glass with a blueish tinge.

Uranium—dull yellow glass.

Cerium—red or orange-colored glass. When the oxides of Cerium and of iron are found combined with silex, it is nearly impossible to detect the former with the blow-pipe.

Manganese—amethystine glass.

Iron—yellowish green glass.

Cobalt—bright blue glass.

Nickel—red or orange-colored glass, which by cooling becomes yellow or nearly colorless.

Copper—greenish glass.

The following metals, if treated alone, are generally reduced to the metallic state with ease.

Silver.	Lead.
Copper.	Bismuth.

Mercury—is readily volatilized: but if any of its ores be mixed with filings of tin, iron, or lead, and heated in a small glass tube closed at one end, the Mercury will sublime into the cool part of the tube, in form of a grey powder, which on agitation runs into globules.

Antimony—sublimes and deposites a white powder on the charcoal.

Zinc—(oxide) becomes yellow, which returns to white on cooling. It does not melt, but assumes a brilliant appearance, and dissipates in white *flocons*, depositing a white powder on the charcoal.

Cadmium—(oxide), on charcoal is almost immediately exhaled, and afterwards deposited in a red or orange-colored powder. This takes place before the reduction of the oxide of zinc; and should white fumes of the latter metal appear, it may be considered that the heat has been urged too far*.

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* Dr. Clarke has discovered the following method of detecting Cadmium in an ore of calamine:—Triturate a small portion of the ore, and place about one-twentieth of a grain of the powder upon a plate of platina; then, directing the blue flame from the blow-pipe towards it, if the ore contains Cadmium, its oxide will be volatilized, and a protoxide of a peculiar reddish-brown color will be deposited on the platina.

Arsenic—discovers itself immediately by its disagreeable alliaceous odor.

Selenium—occasions a sharp unpleasant vapor, smelling somewhat like horse-radish.

Tellurium—is reduced with effervescence and fumes of the peculiar odor of horse-radish; but Berzelius observes, that it is not perceived when the Tellurium is pure, and only arises from the presence of selenium.

Tin—does not melt, but by long exposure is reduced to the metallic state. It is one of the metals which requires much skill in its examination.

THE detection of Acids existing in mineral salts may probably be best effected by the following means:—

Sulphuric.—Place on a globule of silex and soda, fused together, a small particle of the salt; on applying the blow-pipe the bead will take a dark tint, or, if colorless in the liquid state, will become red or orange on cooling.

Nitric—by the detonation produced on heating it with charcoal.

Muriatic.—Form a bead of phosphate of copper, and then add the substance suspected to contain Muriatic acid; on using the blow-pipe, should this acid be present, the bead will be surrounded by a blue flame, bordering on purple, which will continue as long as any of the acid remains.

Iodic—submitted to the same test as the muriatic, yields a flame of a fine deep green, very

different from the green tinge sometimes arising from the fusion of phosphoric salts when they contain ammonia.

Fluoric—by its odor, and action on a glass tube, when the substances containing it are heated with phosphoric acid.

Phosphoric—in many of its combinations, requires for its detection a considerable degree of skill and experience. For some valuable information respecting it, the reader is referred to the excellent treatise of Berzelius.

Carbonic and *Boracic.*—For the detection of these acids, the blow-pipe affords no satisfactory means; the existence of the former may almost always be ascertained by a drop of muriatic acid, which produces effervescence.

HAVING already acknowledged our obligations to the work of Berzelius, we shall conclude with two quotations, which, independently of the information they contain, will enable the student to judge of the mode of operating, and of the attention to be paid to circumstances of apparently minor importance: at the same time they will afford him an opportunity of estimating the value of the acquisition which science has gained by the appearance of the publication.

" CERTAIN bodies have the property of
" forming with borax a limpid glass, which
" preserves its transparency after cooling; but
" which, heated slightly at the exterior flame,
" becomes opaque, and turns to milk white
" or colored; particularly when the flame is
" directed on the glass in an unequal and in-

" termitting manner. Such are the alkaline " earths, yttria, glucine, and zircon; the ox- " ides of cerium, of tantalium, of titanium, &c. " But one condition, necessary for the produc- " tion of this phenomenon, is, that the glass " be saturated, to a certain point, with the " oxide or earth. The same thing does not " happen with silex or alumine, the oxides " of iron or manganese, &c. and the pre- " sence of silex (the vitrification of which with " borax is susceptible of becoming opaque) is " sufficient to prevent the production of the " phenomenon in the earths; so that it does " not take place in the silicates."—Page 75.

SPEAKING of the nitrate of cobalt as a test for alumine, (in p. 107), he observes:—" We " employ this re-agent to ascertain the pre- " sence of alumine and of magnesia, which give " with the oxide of cobalt, after strong igni-

" tion, the former a fine blue color, and the
" latter a pale rose red. Silex does not pre-
" vent the manifestation of these characters.

" THERE are two modes of treating a sub-
" stance by the Nitrate of Cobalt: First, If the
" substance be capable of absorbing a certain
" quantity of the solution, we use a small
" piece. After having put a drop of the solu-
" tion on one side of the fragment, we heat it
" strongly, being careful to avoid fusing it:
" after thus roasting it for some time, the
" piece becomes colored, and if the tinge be
" blue, of more or less purity, we may con-
" clude that the matter subjected to exam-
" ination contains alumine; if it should bor-
" der on red, or rose-color, it is magnesia
" that it contains. In the latter case, we en-
" deavour to make it enter into fusion, because
" fused magnesia not only preserves its red co-

" lor, but even acquires a deeper tinge. The " blue color of alumine remains also after fu- " sion, but under these circumstances it loses " its distinctive character; since fossils which " contain lime, and alkali without alumine, " although not taking a blue color before fus- " ing, give also a blue glass by being melted " with oxide of Cobalt.

" SECONDLY—For the harder substances, " as the crystallized stones, the process is not " the same. We bruise the stone with water " in a small agate mortar, until it is reduced " to a pulpy state; on withdrawing the pestle " from the mass, and holding it in a vertical " position, we raise a drop which hangs sus- " pended at its extremity, and contains the " finest particles of the powdered mineral: we " deposit this drop on charcoal, which absorbs " the moisture, while the powder forms a small

" sediment on the surface; then we add to it
" a drop of the solution of Cobalt, and after-
" wards gradually heat it red hot. During this
" experiment, we must not stop to examine the
" successive tints of blue and red through which
" it passes before decomposing, and which all
" terminate in becoming black; as it is only at
" the instant of the most lively incandescence
" that the characteristic re-action is manifest.
" Should we find the mass begin to detach it-
" self from the charcoal, we may take it, with-
" caution, between the platina forceps, and, ex-
" posing it in this state to the flame of the
" blow-pipe, urge it with greater ease to the
" necessary degree of heat."—Page 81.

FINIS.

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